

**Final Performance Report  
NAG5-3899**

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**Title:** *Search for the Cosmic Infrared Background Radiation using COBE Data*

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**STScI Grant  
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This project was initiated to allow completion of the primary investigation of the Diffuse Infrared Background Experiment (DIRBE) on NASA's Cosmic Background Explorer (COBE) mission, and to study the implications of those findings. The Principal Investigator (PI) on this grant was also the Principal Investigator on the DIRBE team. The project had two specific goals:

Goal 1: Seek improved limits upon, or detections of, the cosmic infrared background radiation using data from the COBE Diffuse Infrared Background Experiment (DIRBE).

Goal 2: Explore the implications of the limits and measured values of the cosmic infrared background for energy releases in the Universe since the formation of the first luminous sources.

Both of these goals have been successfully accomplished.

With respect to the first goal, the PI led the DIRBE team, augmented by the grant-supported post-doctoral fellow Dr. Yichuan Pei, to completion of the observational search for the cosmic infrared background in the DIRBE data. This search was successful, in that the long-sought cosmic infrared background was detected at wavelengths of 140 and 240 micrometers, and useful upper limits were set at eight shorter wavelengths (1.25, 2.2, 3.5, 4.9, 12, 25, 60, and 100 micrometers.) The DIRBE search, astrophysical foreground models, cosmic infrared background results, and initial cosmological implications were fully described in four comprehensive papers published in the *Astrophysical Journal* (listed at the end of this report).

This discovery was announced to the press and the scientific community at the American Astronomical Society meeting in January, 1998. The results were also described by the PI in numerous colloquia at various US research institutions.

Continuing pursuit of the second goal, Y. Pei and the PI collaborated with S. Michael Fall to produce a global cosmic evolution model which provides a self-consistent account of the history of star formation, metals production, and radiation release over cosmic time. The availability of the COBE measurements of the infrared background allowed the model to predict that about half of the energy radiated by stars over cosmic time has been absorbed by cosmic dust and re-radiated at far infrared and submillimeter wavelengths. This conclusion is reasonably consistent with all available data, including measurements or limits on the cosmic background radiations from ultraviolet to submillimeter wavelengths. These results were published in the *Astrophysical Journal* (listed at the end of this report).

The PI has presented invited talks reviewing the COBE measurements of the cosmic infrared background and their implications at international scientific meetings, including the Conference "ISO Surveys of a Dusty Universe" held at Ringberg Castle in Germany in November 1999, and IAU Symposium 204, "The Extragalactic Infrared Background and its Cosmological Implications", held in Manchester, England in August 15-18, 2000 as part of the 24<sup>th</sup> IAU General Assembly. The PI was a member of the Scientific Organizing Committee for IAU Symposium 204, and was a co-editor of the Proceedings, now published by the Astronomical Society of the Pacific. His paper at the IAU Symposium is published in the Proceedings (listed at the end of this report).

Finally, the PI collaborated with E. Dwek in preparing an invited comprehensive review article on current knowledge of the cosmic infrared background, summarizing all of the observational techniques used to provide information about it, and the astrophysical and cosmological implications of these measurements. This review has been published in the most recent edition of "Annual Review of Astronomy and Astrophysics".

The following publications have resulted from the work supported under this grant:

"The COBE Diffuse Infrared Background Experiment Search for the Cosmic Infrared Background: I. Limits and Detections", M. G. Hauser, R. G. Arendt, T. Kelsall, E. Dwek, N. Odegard, J. L. Weiland, H. T. Freudenreich, W. T. Reach, R. F. Silverberg, S. H. Moseley, Y. C. Pei, P. Lubin, J. C. Mather, R. A. Shafer, G. F. Smoot, R. Weiss, D. T. Wilkinson, and E. L. Wright. *ApJ*, 508, 25 (1998).

"The COBE Diffuse Infrared Background Experiment Search for the Cosmic Infrared Background: II. Model of the Interplanetary Dust Cloud", T. Kelsall, J. L. Weiland, B. A. Franz, W. T. Reach, R. G. Arendt, E. Dwek, H. T. Freudenreich, M. G. Hauser, S. H. Moseley, N. P. Odegard, R. F. Silverberg, and E. L. Wright. *ApJ*, 508, 44 (1998).

"The COBE Diffuse Infrared Background Experiment Search for the Cosmic Infrared Background: III. Separation of the Galactic Emission from the Infrared Sky Brightness", R. G. Arendt, N. Odegard, J. L. Weiland, T. J. Sodroski, M. G. Hauser, E. Dwek, T. Kelsall, S. H. Moseley, R. F. Silverberg, D. Leisawitz, K. Mitchell, W. T. Reach, and E. L. Wright. *ApJ*, 508, 74 (1998).

"The COBE Diffuse Infrared Background Experiment Search for the Cosmic Infrared Background: IV. Cosmological Implications", E. Dwek, R. G. Arendt, M. G. Hauser, D. Fixsen, T. Kelsall, D. Leisawitz, Y. C. Pei, E. L. Wright, J. C. Mather, S. H. Moseley, N. Odegard, R. Shafer, R. F. Silverberg, and J. L. Weiland. *ApJ*, 508, 106 (1998).

"Cosmic Histories of Stars, Gas, Heavy Elements, and Dust in Galaxies", Yichuan C. Pei, S. Michael Fall, and Michael G. Hauser. *ApJ*, 522, 604 (1999).

"The Far Infrared and Submillimeter Diffuse Extragalactic Background", M. G. Hauser, in *Proceedings of IAU Symposium 204, The Extragalactic Infrared Background and its Cosmological Implications*, eds. Martin Harwit and Michael G. Hauser, ASP Conference Series 204 (San Francisco: ASP), 101, (2001).

*Proceedings of IAU Symposium 204, The Extragalactic Infrared Background and its Cosmological Implications*, eds. Martin Harwit and Michael G. Hauser, ASP Conference Series 204 (San Francisco: ASP), 525 pp. (2001).

"The Cosmic Infrared Background: Measurements and Implications", Michael G. Hauser and Eli Dwek, *ARAA*, 39, 249 (2001)